

Hornchurch High School, Broadstone Road, Hornchurch



Planning Noise Compliance Report
Report 30423.PCR.01 Rev A

Partnership Learning

Report 30423.PCR.01 Rev A			
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A	28/01/26: Report updated to address Local Authority comments, including adoption of a 10 dB below background noise criterion (27 dB(A)) and related updates to assessment and mitigation.	D	
B		E	
C		F	
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List of Attachments

30423. TH1.01–0.2	Environmental Noise Time History
30423.Daytime.LA90.01-02	Statistical analysis for representative daytime L_{A90}
30423.Night-time.LA90.01-02	Statistical analysis for representative night-time L_{A90}
Appendix A	Glossary of Acoustics Terminology
Appendix B	Acoustic Calculations
Appendix C	Anti-Vibration Mounting Specification Reference Document

1.0 INTRODUCTION

KP Acoustics Ltd has been commissioned by Partnership Learning to undertake a noise impact assessment of a proposed plant unit installation serving the building at Hornchurch High School, Broadstone Road, Hornchurch, RM12 4AJ.

An environmental noise survey has been undertaken on site in order to prepare a noise impact assessment in accordance with BS4142:2014 '*Method for rating and assessing industrial and commercial sound*' as part of the planning requirements of the London Borough of Havering.

This report presents the methodology and results from the environmental survey, followed by calculations in accordance with BS4142 to provide an indication as to the likelihood of the noise emissions from the proposed plant unit installation having an adverse impact on the closest noise sensitive receiver. Mitigation measures will be outlined as appropriate.

2.0 SITE SURVEYS

As shown in Figure 2.1, the site is bounded by residential properties and Apollo CI to the north, school buildings and further residential areas to the west, additional school facilities including tennis and basketball courts to the south, and residential properties to the east.



Figure 2.1 Site Location Plan (Image Source: Google Maps)

Initial inspection of the site revealed that the background noise profile at the monitoring location was typical of a suburban school environment, with a dominant noise source including occasional vehicle movements on nearby residential roads and intermittent activity within the school grounds.

2.1 Environmental Noise Survey Procedure

Continuous automated monitoring was undertaken for the duration of the noise survey between 15:00 on 15/05/2025 and 10:00 on 19/05/2025.

The environmental noise measurement position, proposed plant installation locations, and the closest noise sensitive receiver relative to the plant installations are described within Table 2.1

Icon	Descriptor	Location Description
①	Noise Measurement Position 1	The microphone was installed on the roof at the south of the building using a tripod, as shown in Figure 2.2. The microphone was positioned within free-field conditions at least approx. 1.5 metres from the nearest surface.
②	Noise Measurement Position 2	The microphone was installed on the roof at the north of the building using a tripod, as shown in Figure 2.2. The microphone was positioned within free-field conditions at least approx. 1.5 metres from the nearest surface.
	Nearest noise sensitive receptors	Rear façade. Ground floor window. Residential house to the east.
	Proposed plant installation location	Proposed plant installations are outlined in Section 5.1.

Table 2.1 Measurement positions and descriptions

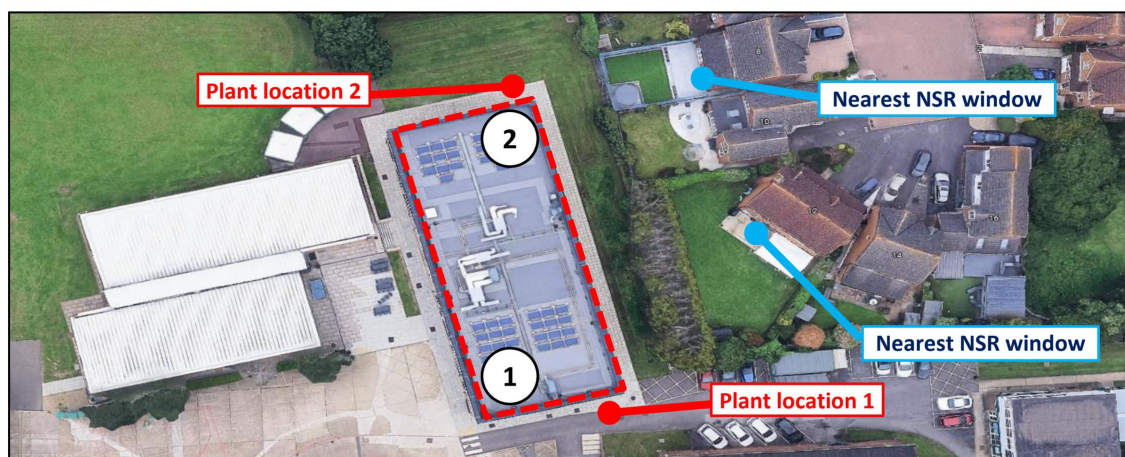


Figure 2.2 Site measurement positions (Image Source: Google Maps)

The choice of the position was based both on accessibility and on collecting representative noise data in relation to the nearest noise sensitive receiver and the proposed plant installation.

Weather conditions were generally dry with light winds and therefore suitable for the measurement of environmental noise. The measurement procedure complied with ISO 1996-2:2017 Acoustics '*Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels*'.

2.2 Equipment

The equipment calibration was verified before and after use and no abnormalities were observed. The equipment used is described within Table 2.2.

Measurement instrumentation		Serial no.	Calibration Date	Cert no.
Noise Kit 28	NTI Audio XL2 Class 1 Sound Level Meter	A2A-21140-E0	23/05/2023	UK-23-063
	Free-field microphone NTI Acoustics MC230A	A23592		
	Preamp NTI Acoustics MA220	10981		
	NTI Audio External Weatherproof Shroud	-	-	-
Noise Kit 38	NTI Audio XL2 Class 1 Sound Level Meter	A2A-23182-E1	12/09/2023	UK-23-104
	Free-field microphone NTI Acoustics MC230A	A25833		
	Preamp NTI Acoustics MA220	13818		
	NTI Audio External Weatherproof Shroud	-	-	-
B&K Type 4231 Class 1 Calibrator		2147411	14/06/2024	UKAS24/06438

Table 2.2 Measurement instrumentation

3.0 RESULTS

The L_{Aeq} : 5min, L_{Amax} : 5min, L_{A10} : 5min and L_{A90} : 5min acoustic parameters were measured throughout the duration of the survey. Measured levels are shown as a time history in Figure 30423.TH1.

Representative background noise levels are shown in Table 3.1 for daytime and night-time.

It should be noted that the representative background noise level has been derived based on the guidance of BS4142 Section 8.1.4 from the $L_{A90,5min}$ levels measured during the environmental noise survey undertaken on site, as shown in 30423.Daytime L90.TH1 and 30423.Night-time L90.TH1 attached. The corresponding operational time periods for the assessment are also indicated in Table 3.1.

Time Period	Representative background noise level L_{A90} dB(A) measured at Position 1	Representative background noise level L_{A90} dB(A) measured at Position 2
Daytime (07:00-23:00)	37	37
Night-time (23:00-07:00)	37	32
Operating hours (08:00-17:00)	38	37

Table 3.1 Representative background noise levels

4.0 NOISE ASSESSMENT GUIDANCE

4.1 BS4142: 2014 'Methods for rating and assessing industrial and commercial sound'

British Standard BS4142:2014 'Methods for rating and assessing industrial and commercial sound' describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes
- Sound from fixed installations which comprise mechanical and electrical plant and equipment
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

This Standard compares the Rating Level due to the noise source/s under assessment for a one-hour period during the daytime (07:00 – 23:00 hours) and a fifteen-minute period during the night-time (23:00 – 07:00 hours) with the existing background noise level in terms of an L_{A90} when the noise source is not operating.

It should be noted that the Rating Level is the Specific Sound Level in question ($L_{Aeq, Tr}$), including any relevant acoustic feature corrections, as follows:

- **Tonality** – *‘For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible’*

Manufacturer noise data for the proposed plant units is provided in octave bands only. As third-octave band data is not available, a formal tonal assessment in accordance with Annex C of BS4142 cannot be undertaken. However, a review of the available octave-band data does not indicate any dominant frequency components or irregularities that would suggest tonal characteristics. On this basis, the proposed plant is not considered to be tonal and no tonal correction has been applied.

- **Impulsivity** – *‘A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible’*
- **Intermittency** – *‘If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied’*
- **Other sound characteristics** – *‘Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied’*

Once the Rating Level has been obtained, the representative background sound level is subtracted from the Rating Level to obtain an initial estimate of the impact, as follows:

- Typically, the greater this difference, the greater the magnitude of the impact
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context
- A difference of around +5 dB could be an indication of an adverse impact, depending on the context
- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context

NOTE: Adverse impacts may include but not be limited to annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

4.2 Local Authority Guidance

The guidance provided by the London Borough of Havering for noise emissions of new plant in this instance is based on email correspondence dated 19/12/2019 from David Cant, Senior Public Protection Officer. The relevant extract is provided below:

"We unfortunately don't have a supplementary planning guidance document for noise containing design criteria.

If you were to look through a great many of Havering's previous planning consents you'll tend to find a standard condition requiring a rating level of 10dB below background. Whether such a stringent standard is necessary or even suitable in situations other than where noise creep is a concern is arguably open to challenge. Depending on the project you're looking to apply it to, I'd suggest you work towards it and if necessary I'm sure you could argue a case for LA90 - 5dB or greater depending on context etc."

As the school is a significant distance from surrounding noise sensitive receivers and there is a low risk of noise creep in this location, the target criterion of -5dB below background is considered to be an appropriate target.

4.3 Noise Emissions Criterion

As the proposed units are expected to operate during only daytime hours, the criterion has been set as shown in Table 4.1 in order to comply with the above requirements.

This reflects the operational nature of the site as a school, with no requirement for night-time operation of the proposed plant. In this context, and taking into account the proposed mitigation measures, the adopted daytime criterion is considered appropriate in accordance with BS4142.

A conservative noise emissions criterion of 10 dB below the representative background noise level has been adopted for this assessment, in line with the Local Authority's standard requirement.

Time Period	Maximum Plant Noise Emissions Criterion at Nearest Residential Receiver
Operating hours (8:00 to 17:00)	27dB(A)

Table 4.1 Proposed noise emissions criterion

The proposed plant is not considered to be tonal or impulsive in character; however a penalty has been applied for potential intermittency.

5.0 NOISE IMPACT ASSESSMENT

5.1 Proposed Plant Installations

It is understood that the proposed plant installation is comprised of the following units at the noted locations. The plant units are proposed to operate during the daytime (8:00 to 17:00), and the assessment reflects this operational condition. The locations of the installation are shown in Figure 2.2 above.:

South: Position 1

- 1 No. Mitsubishi PUHY-P350YNW-A2
- 1 No. Mitsubishi PUHY-P650YNW-A2

North: Position 2

- 1 No. Mitsubishi PUHY-P350YNW-A2
- 1 No. Mitsubishi PUHY-P650YNW-A2

The noise emission levels as provided by the manufacturer for the units are shown in Table 5.1.

Unit	Descriptor	Octave Frequency Band (Hz)								Overall (dBA)
		63	125	250	500	1k	2k	4k	8k	
PUHY-P350YNW-A2	SPL@1m (dB)	69	63	64	62	56	51	46	40	63
PUHY-P650YNW-A2	SPL@1m (dB)	75	67	68	66	60	56	52	48	67

Table 5.1 Plant Units Noise Emission Levels as provided by the manufacturer

The closest noise sensitive receivers to the proposed installation locations have been identified as ground floor windows of residential properties located to the east of the site — one adjacent to the southern end of the building, and another near the northern end.

The northern receiver is located approximately 20 metres from the proposed plant installation at the north end of the roof, also as represented in Figure 2.2.

The southern receiver is located approximately 32 metres from the proposed plant installation at the south end of the roof, also as represented in Figure 2.2.

5.2 Calculations

Taking all acoustic corrections into consideration, the noise level contribution expected at the closest residential windows to the north and south from the proposed plant installations would be as shown in Table 5.2. Detailed calculations are shown in Appendix B.

Receiver	Time (Hours)	Criterion	Rating Level at 1m From the Closest Noise Sensitive Window
Ground Floor Window of the Residential Building to the East (Position 1)	08:00 to 17:00	27dB(A)	25dB(A)
Ground Floor Window of the Residential Building to the East (Position 2)	8:00 to 17:00		27dB(A)

Table 5.2 Predicted noise level and criterion at nearest noise sensitive location

As shown in Appendix B and Table 5.2, transmission of noise to the nearest sensitive windows, from the proposed plant unit installation should satisfy the criterion of the Local Authority, providing that the mitigation measures outlined in Section 6 are implemented.

6.0 NOISE CONTROL MEASURES

6.1 Acoustic Enclosure

To control the noise emissions from the plant installation, we would recommend that an acoustic enclosure is installed according to the insertion loss specification below.

For clarity, the mitigation strategy assessed within this report is based solely on the provision of fully enclosed acoustic enclosures with defined insertion loss performance, as specified in Table 6.1. No reliance is placed on any form of open or decorative barrier.

Unit Ref.	Insertion Loss Levels (dB) in each octave frequency band (Hz)							
	63	125	250	500	1k	2k	4k	8k
Position 2 - 1 No. Mitsubishi PUHY- P350YNW-A2	10	12	19	27	34	27	11	1
Position 2 - 1 No. Mitsubishi PUHY- P650YNW-A2	10	12	19	27	34	27	11	1

Table 6.1 Insertion loss figures to be provided by acoustic enclosure

The relevant plant units must be completely enclosed for optimal noise reduction (including a top panel/weather hood). Ventilation openings for cooling must not compromise sound insulation. Doors, access panels, windows, ducts, and cable penetrations shall be treated so as to maintain the proposed acoustic specification when fully assembled.

The manufacturer/supplier will need to ensure that the enclosure[s] can achieve the above specifications in-situ.

In instances where a manufacturer/supplier proposes an enclosure that deviates from this specification, KPA should be informed so that we may comment upon the acceptability.

6.2 Anti-Vibration Mounting Strategy

In the case of all plant units, appropriate anti-vibration mounts should be installed in order to ensure that vibrations do not give rise to structure-borne noise. Appendix C outlines detailed advice in order to ensure that the system installer selects the appropriate anti-vibration mount for the installation.

It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail.

7.0 CONCLUSION

An environmental noise survey has been undertaken at Hornchurch High School, Broadstone Road, Hornchurch, RM12 4AJ, by KP Acoustics Ltd between 15:00 on 15/05/2025 and 10:00 on 19/05/2025. The results of the survey have enabled criteria to be set for noise emissions.

Manufacturer's noise data of proposed plant units has been used to obtain Specific and Rated Noise Level at the nearest noise sensitive receiver in accordance with British Standard BS4142:2014 for compliance with London Borough of Havering requirements.

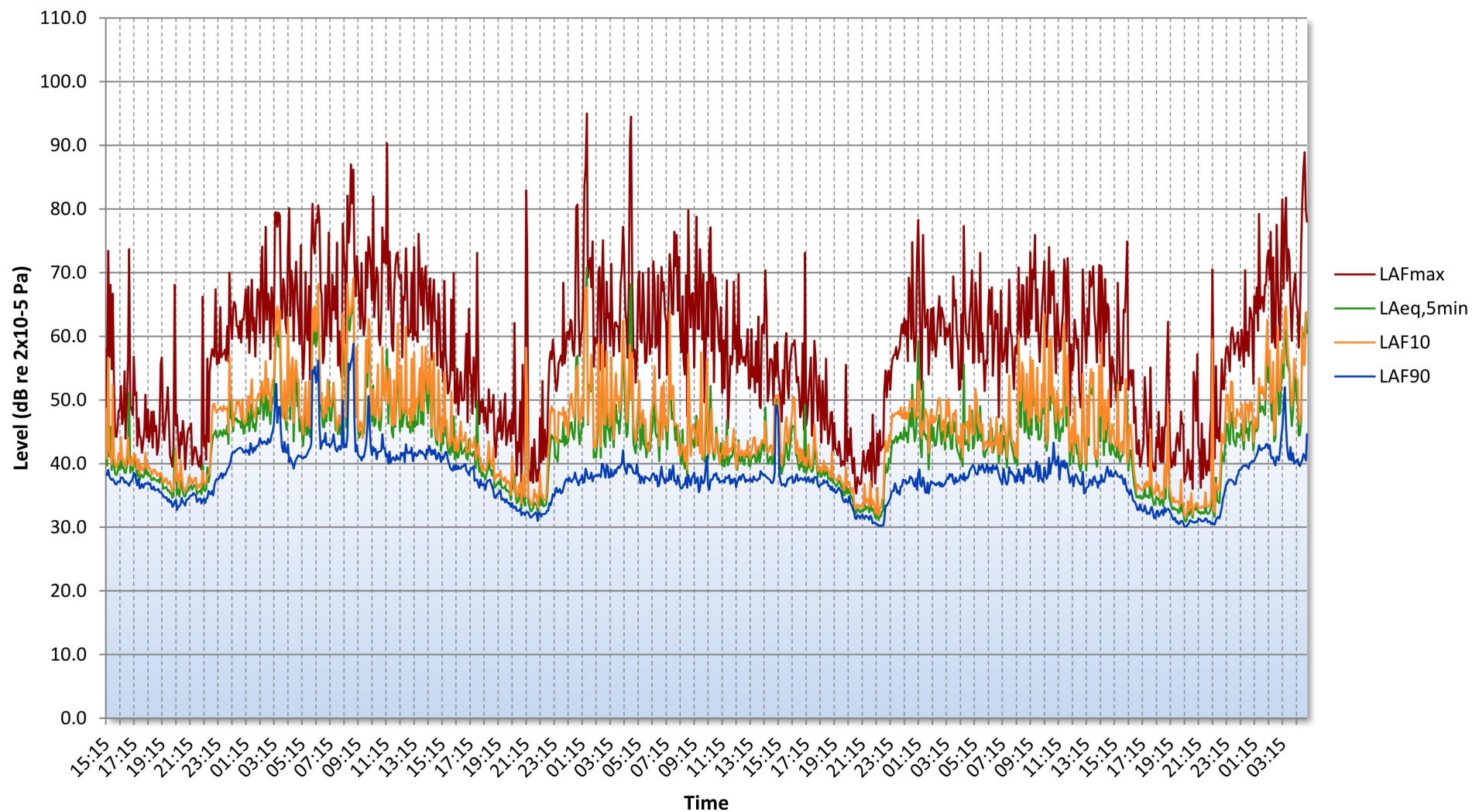
The rating level was compared with the representative background noise level to assess the likelihood of impact considering the environmental noise context of the area as per the requirements of BS4142:2014.

It has been concluded that noise emissions from the proposed plant units are not expected to result in an adverse impact on the nearest residential receptors, provided that the acoustic enclosures specified in Section 6 are implemented.

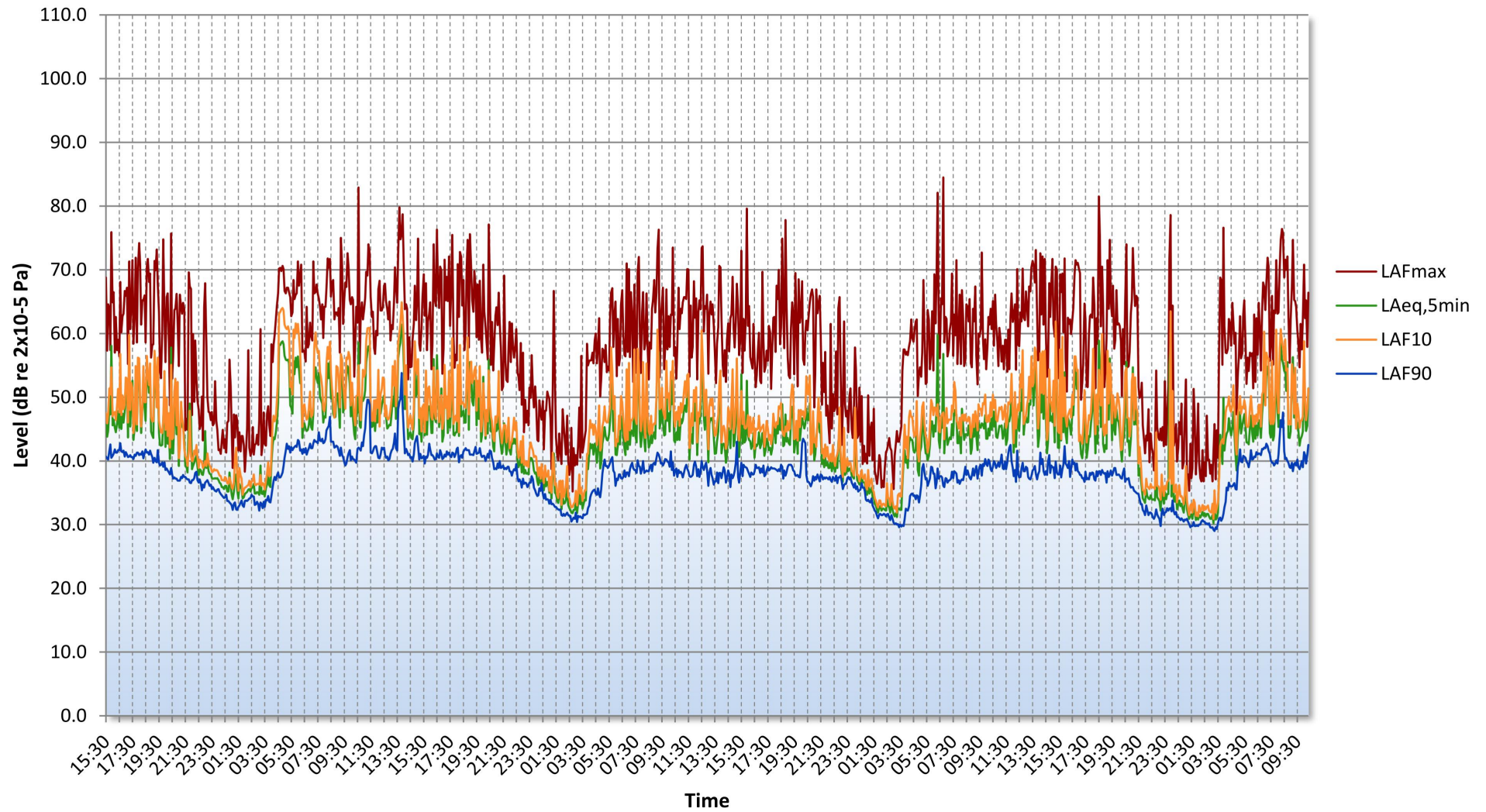
As such, the proposed installation is not expected to cause a significant noise impact on the surrounding environment and is considered acceptable in acoustic terms.

Compliance with the adopted noise criteria is dependent upon the implementation of the mitigation measures outlined in Section 6. Ongoing compliance following installation would be controlled by the Local Authority through appropriate planning conditions.

HORNCHURCH HIGH SCHOOL - Position 1
Environmental Time History
15/05/2025 to 19/05/2025



HORNCHURCH HIGH SCHOOL - Position 2
Environmental Time History
15/05/2025 to 19/05/2025



HORNCHURCH HIGH SCHOOL - Position 1
Representative Daytime Background Noise Level
15/05/2025 to 19/05/2025

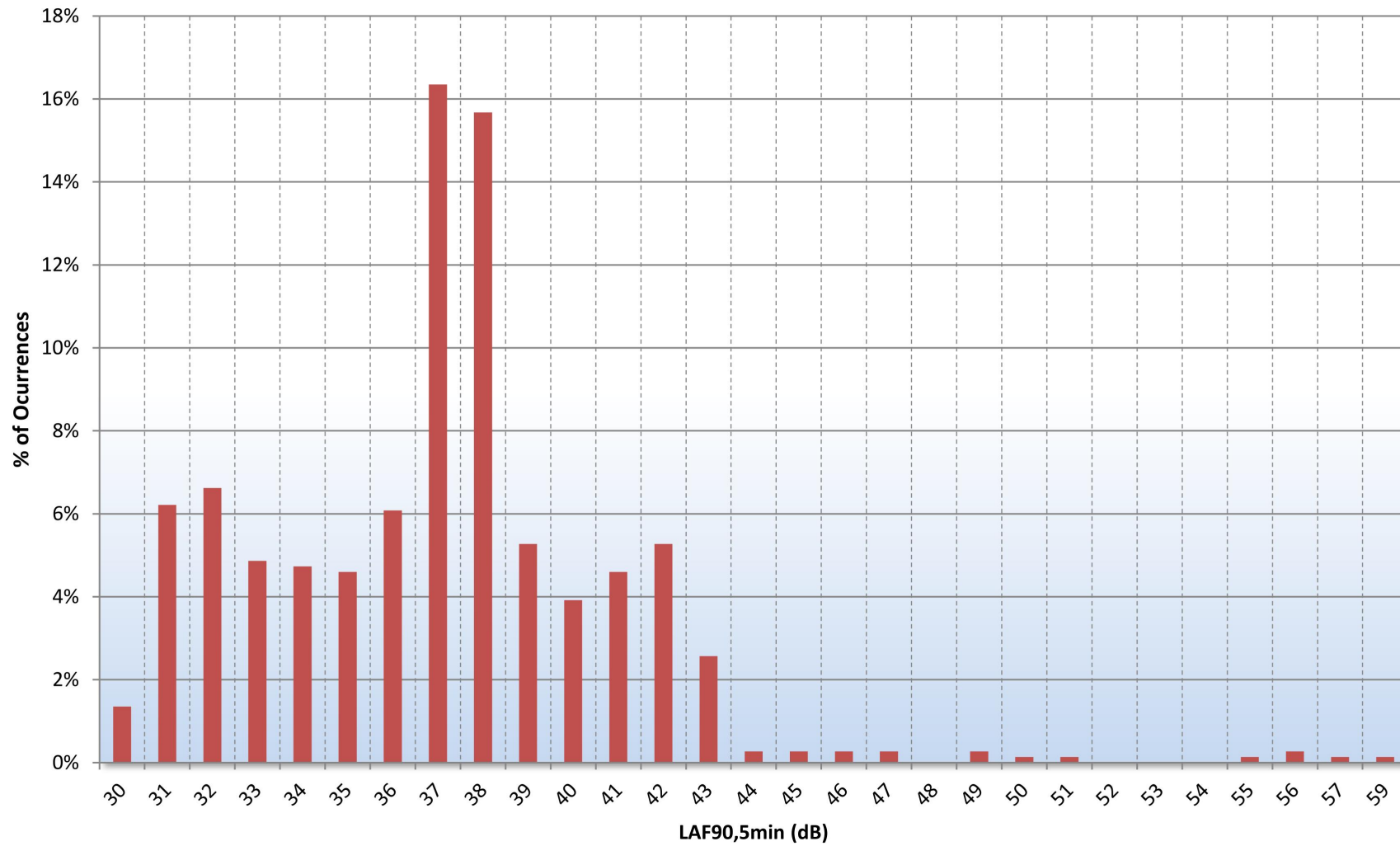


Figure 30423.Daytime L90.TH1.01

HORNCHURCH HIGH SCHOOL - Position 2
Representative Daytime Background Noise Level
15/05/2025 to 19/05/2025

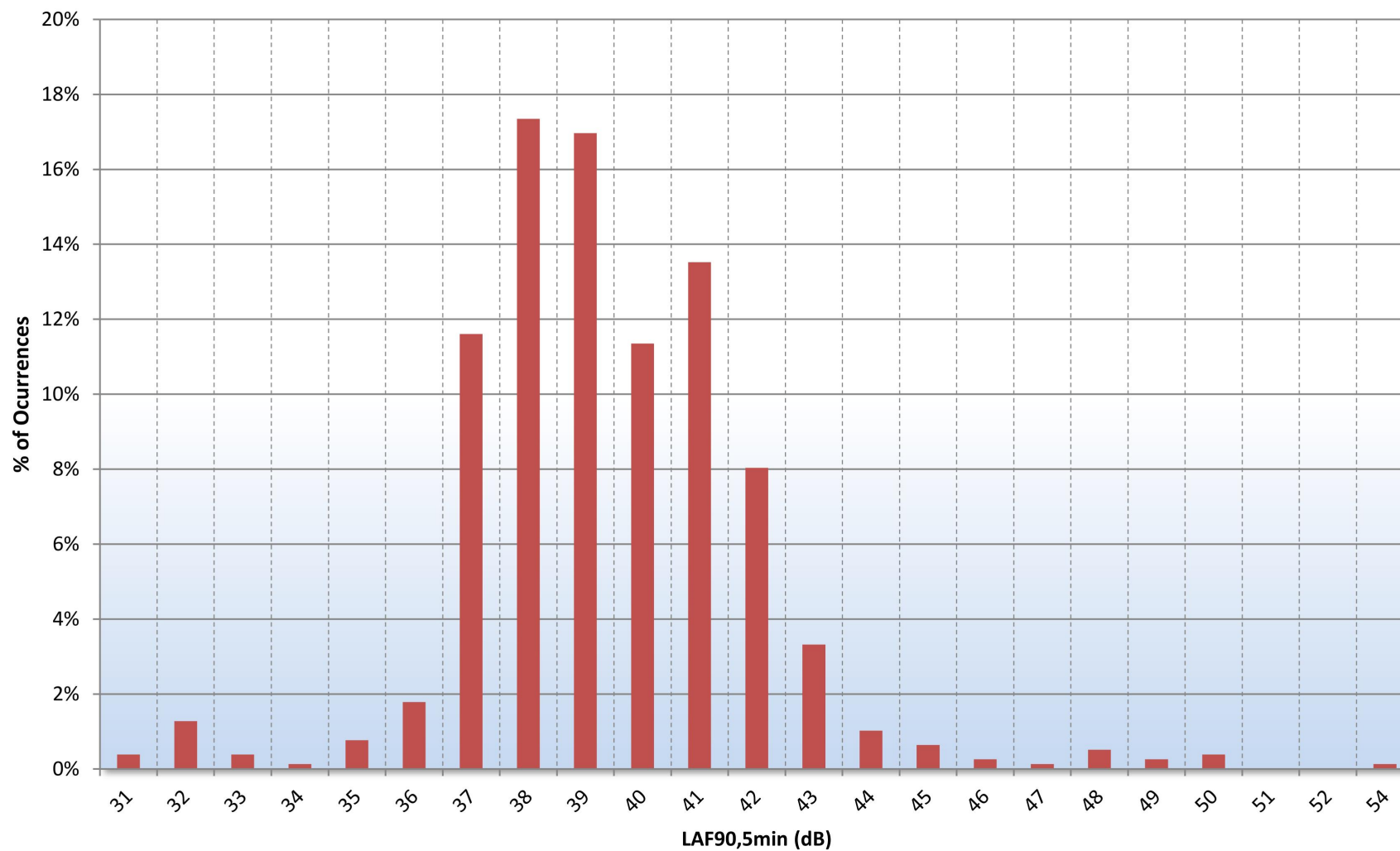


Figure 30423.Daytime L90.TH2

HORNCHURCH HIGH SCHOOL - Position 1
Representative Night-time Background Noise Level
15/05/2025 to 19/05/2025

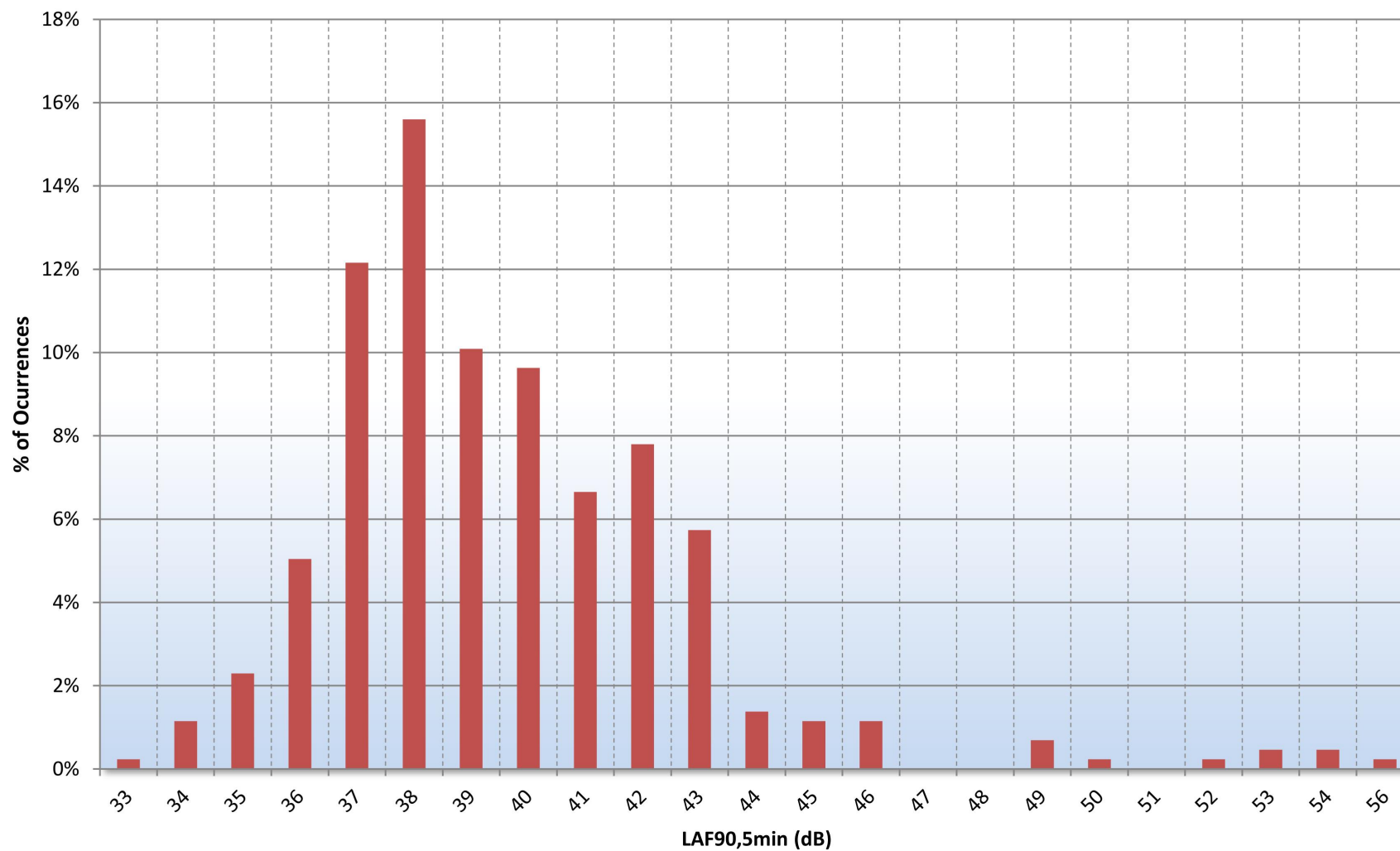


Figure 30423.Night-time L90.TH1.01

HORNCHURCH HIGH SCHOOL - Position 2
Representative Night-time Background Noise Level
15/05/2025 to 19/05/2025

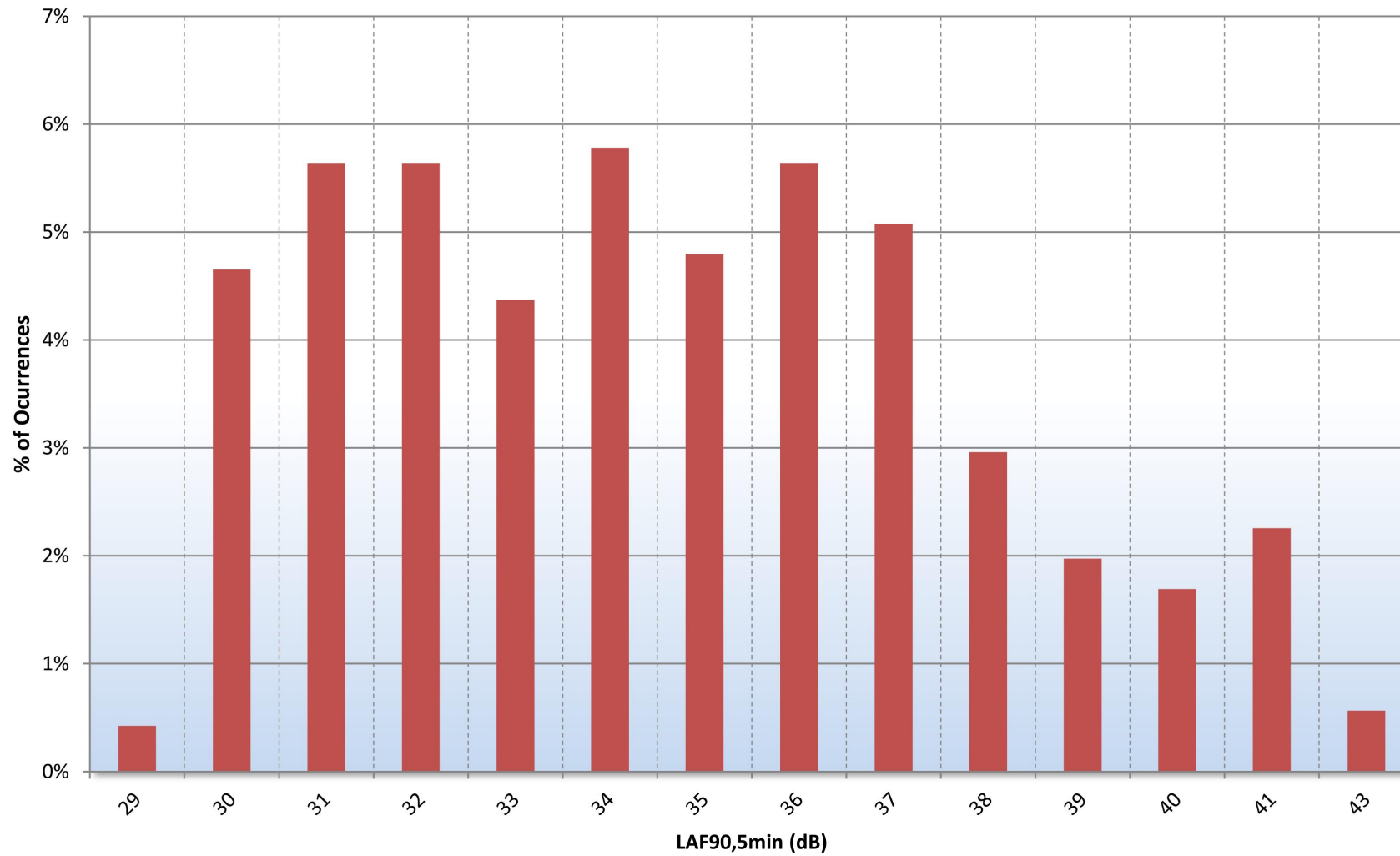


Figure 30423.Night-time L90.TH2

GENERAL ACOUSTIC TERMINOLOGY

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq} . The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for no more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise.

L_{90}

This is the level exceeded for no more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Environmental noise terms are defined in BS7445, *Description and Measurement of Environmental Noise*.

APPLIED ACOUSTIC TERMINOLOGY

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

APPENDIX B HORNCHURCH HIGH SCHOOL, BROADSTONE ROAD, RM12 4AJ

PLANT NOISE EMISSIONS CALCULATIONS

Source: Front Condenser Receiver: Ground Floor Residential Window	Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Position 1- South									
Mitsubishi PUHY-P350YNW-A2 (Sound Pressure Level @1m)	69	63	64	62	56	51	46	40	63
Correction due to surface reflections (2), dB	6	6	6	6	6	6	6	6	
Minimum attenuation due to building envelope, dB	-13	-16	-20	-24	-25	-25	-25	-25	
Minimum attenuation provided by distance (40m), dB	-32	-32	-32	-32	-32	-32	-32	-32	
Minimum attenuation required by proposed acoustic enclosure, dB									
Total Specific Noise Level of above units at Receiver	30	21	18	12	5	0	-5	-11	14
Mitsubishi PUHY-P650YNW-A2 (Sound Pressure Level @1m)	75	67	68	66	60	56	52	48	67
Correction due to surface reflections (2), dB	6	6	6	6	6	6	6	6	
Minimum attenuation due to building envelope, dB	-13	-16	-20	-24	-25	-25	-25	-25	
Minimum attenuation provided by distance (32m), dB	-30	-30	-30	-30	-30	-30	-30	-30	
Minimum attenuation required by proposed acoustic enclosure, dB									
Total Specific Noise Level of above units at Receiver	38	27	24	18	11	7	3	0	21
Total Both Units	38	28	25	19	12	8	4	0	22
BS4142 Acoustic Feature Corrections									
Intermittency	3	3	3	3	3	3	3	3	
Total Rating Noise Level of all Plant Unit Installations at Receiver	41	31	28	22	15	11	7	3	25

Design Criterion

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Source: Front Condenser Receiver: Ground Floor Residential Window	Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Position 2- North									
Mitsubishi PUHY-P350YNW-A2 (Sound Pressure Level @1m)	69	63	64	62	56	51	46	40	63
Correction due to surface reflections (2), dB	6	6	6	6	6	6	6	6	
Minimum attenuation provided by distance (20m), dB	-26	-26	-26	-26	-26	-26	-26	-26	
Minimum attenuation required by proposed acoustic enclosure, dB	-10	-12	-19	-27	-34	-27	-11	-1	
Total Specific Noise Level of above units at Receiver	39	31	25	15	2	4	15	19	23
Mitsubishi PUHY-P650YNW-A2 (Sound Pressure Level @1m)	75	67	68	66	60	56	52	48	67
Correction due to surface reflections (2), dB	6	6	6	6	6	6	6	6	
Minimum attenuation provided by distance (39m), dB	-32	-32	-32	-32	-32	-32	-32	-32	
Minimum attenuation required by proposed acoustic enclosure, dB	-10	-12	-19	-27	-34	-27	-11	-1	
Total Specific Noise Level of above units at Receiver	39	29	23	13	0	3	15	21	24
Total Both Units	42	33	27	17	4	7	18	0	24
BS4142 Acoustic Feature Corrections									
Intermittency	3	3	3	3	3	3	3	3	
Total Rating Noise Level of all Plant Unit Installations at Receiver	45	36	30	20	7	10	21	3	27

Design Criterion

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ANTI-VIBRATION MOUNTING REFERENCE DOCUMENT

1.0 GENERAL

- 1.1.1 All mountings must provide suitable static deflection when under the equipment weight. Mounting selection should allow for any eccentric load distribution or torque reaction so that the design deflection is achieved on all mountings under operating conditions.
- 1.1.2 A positioning or restraining device should be provided where required, to prevent the equipment position changing if its load changes (e.g. during maintenance). The device shall consist of a stud passing through an oversize hole with a nut and locknut providing restraint, with a fibre or neoprene washer fitted between nut and restraining member leaving a clearance of at least 3mm.
- 1.1.3 It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention should be paid to mountings which will be exposed to atmospheric conditions to prevent corrosion.
- 1.1.4 All mountings shall be colour coded, or otherwise marked, to indicate their load capacity, to facilitate identification during installation.
- 1.1.5 Where use of resilient supports allows omission of pipe flexible connections for vibration/noise isolation, it shall be the Mechanical Services Consultant's or Contractor's responsibility to decide whether such devices are required to compensate for misalignment or thermal strain.

2.0 MOUNTINGS

2.1 Caged Spring Type

- 2.1.1 Each mounting shall consist of cast or fabricated telescopic top and bottom housings enclosing one or more helical steel springs as the principal isolation elements and shall incorporate a built-in levelling device. The housing should be designed to permit visual inspection of the springs after installation, i.e. the spring must not be totally enclosed.
- 2.1.2 The springs shall have an outside diameter of not less than 75% of the operating height and be selected to have at least 50% overload capacity before becoming coil-bound.
- 2.1.3 The bottom plate of each mounting shall have bonded to it a rubber/neoprene pad designed to attenuate any high frequency energy transmitted by the springs.
- 2.1.4 Mountings incorporating snubbers or restraining devices shall be designed so that the snubbing, damping, or restraining mechanism is capable of being adjusted to have no significant effect during the normal running of the isolated machine.
- 2.1.5 All nuts, bolts or other elements used for adjustment of a mounting shall incorporate locking mechanisms to prevent the isolator going out of adjustment due to vibration or accidental or unauthorised tampering.

2.2 Open Spring Type

- 2.2.1 Each mounting shall consist of one or more helical steel springs as the principal isolation elements and shall incorporate a built-in levelling device.
- 2.2.2 The springs shall be fixed or otherwise securely located to cast or fabricated top and bottom plates, shall have an outside diameter of not less than 75% of the operating height, and shall be selected to have at least 50% overload capacity before becoming coil-bound.
- 2.2.3 The bottom plate shall have bonded to it a rubber/ neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

2.3 Rubber/Neoprene Type

- 2.3.1 Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant rubber/neoprene. Each mounting shall be capable of being fitted with a levelling device and should have bolt holes in the base plate and a threaded metal insert in the top plate so that they can be bolted to the floor and equipment where required.

2.4 Hangers

- 2.4.1 Hangers shall incorporate a helical steel spring or neoprene in shear element, as required, located securely in a steel cage. The clearance hold at the bottom of the cage should allow lateral movement of the lower anger rod of at least 15 degrees included angle.
- 2.4.2 If hangers incorporate a positions device, this should include a locking mechanism to prevent the hanger going out of adjustment either due to vibration or tampering.

3.0 PLANT BASES

3.1 A.V. Rails

- 3.1.1 An A.V. Rail shall comprise a steel beam with two or more height-saving brackets. The steel sections must be sufficiently rigid to prevent undue strain in the equipment and if necessary, should be checked by the Structural Engineer.

3.2 Steel Plant Bases

- 3.2.1 Steel plant bases shall comprise an all-welded steel framework of sufficient rigidity to provide adequate support for the equipment and be fitted with isolator height saving brackets. The frame depth shall be approximately $1/10^{\text{th}}$ of the longest dimension of the equipment with a minimum of 150 mm. This form of base may be used as a composite A.V. rail system.

3.3 Concrete Inertia Base (for use with steel springs)

- 3.3.1 These shall consist of an all-welded steel pouring framework with height saving brackets, and a frame depth of approximately $1/12^{\text{th}}$ of the longest dimension of the equipment, with a minimum of 100 mm. The bottom of the pouring frame should be blanked off, and concrete (2300 kg/m^3) poured in over steel reinforcing rods positioned 35 mm above the bottom. The inertia base should be sufficiently large to provide support for all parts of the equipment, including any components which over-hang the equipment base, such as suction and discharge elbows on centrifugal pumps.
- 3.3.2 A typical rule of thumb is that the ratio of mass of the base to mass of the supported equipment should be 1.5 : 1.0 for most conventional equipment, including pumps. However, this could rise to 5.0 : 1.0 for equipment with large lateral out-of-balance forces.

3.4 Concrete Split Plinth Bases

- 3.4.1 These should comprise a concrete inertia base of sufficient size to permit support for all parts of the equipment, including any components which overhang the equipment base, such as suction and discharge elbows on centrifugal pumps. The inertia base should be cast onto a permanent bottom shuttering and supported on the specified neoprene mounts or pads, the whole resting on a plinth as required. It should be noted that the construction of concrete bases on cork, expanded polystyrene or mineral wool slabs is not normally permitted. Where neoprene pads are used, small areas of pad must be equally spaced to provide the correct deflection. The supplier should advise the correct number, dimensions and locations of such pads.